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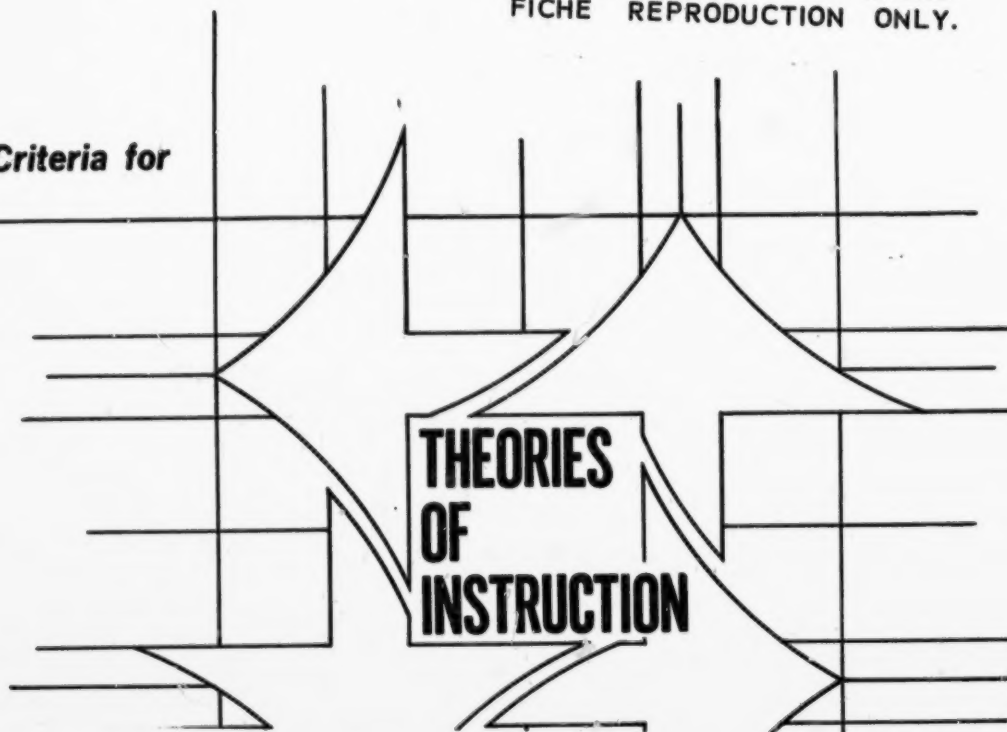
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This booklet is designed to provide guidelines for those responsible for creating curricular or instructional systems and for those determining their use in schools. An introductory chapter, "The Concept of Theory of Instruction," describes uses of the term "theory" and the development of scientific theories. Chapter 2, "Instructional Theory--Looking Backward and Forward," discusses the relationship of theory to data and to values, the components of a statement of theory, the use of technical language, the use of generalization in theory building, and the validation of theories. Chapter 3, "Criteria for Assessing the Formal Properties of Theories of Instruction," lists 10 criteria which apply to the analysis of any scientific theory and presents illustrations of their applicability to instruction. Chapter 4, "The Functions of Instructional Theory," discusses areas in which instructional theory can be assessed for its utility value research, teacher behavior, teacher education and supervision, and curriculum development. Appended are two papers by Ira Gordon, one demonstrating one use to which the assessment criteria may be put (examination of printed curriculum materials in relation to chapter 3 specifications), and one presenting a model for curriculum development decisionmaking on the local level. (JS)

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T HIS pamphlet is dedicated to the memory of Dr. Kimball Wiles, late Dean of the College of Education, University of Florida, and a former President of ASCD. It was during his tenure of office that the ASCD Commission on Instructional Theory was established. His vision, foresight, drive, and encouragement were often a spur to the Chairman in keeping the effort going. His loss is felt not only professionally but in a deeply personal sense.

Foreword

ONE of the great needs of teachers in the nation's classrooms is a knowledge of purpose behind decisions in the areas of curriculum and instruction. This was forcefully brought home to me many years ago when a young teacher dropped into my office, after school, to relate his great success in having a breakfast prepared by the children at school that day. His enthusiasm was unlimited, and, after hearing all that had transpired, I asked, "Dick, why did you have this experience for the children?" The young man was temporarily shocked, hesitated for a moment, and then replied, "Well, we had one last year and the children enjoyed it." Further probing elicited no carefully worked out purpose regarding specific learnings he hoped to achieve with the children.

If each teacher should ask himself each day, "Why am I doing this with the children?" the effectiveness of education would be magnified a hundredfold.

Criteria for Theories of Instruction attempts to provide guidelines for supervisors and teachers as they look critically at proposed statements of instructional theory. Hopefully, this statement, prepared by the ASCD Commission on Instructional Theory, will accomplish more than this. It is a potent delineation of the truth that curriculum theory must be built upon more than personal opinion and judgment, more than happenstance. The quality of education of today's children and youth is too critical in the affairs of our nation to provide anything but educational experiences deeply rooted in knowledge of the learner, of society, and of the nature of learning itself. To this end, the Commission has rendered a significant service.

April 1968

MURIEL CROSBY
President, 1968-69
Association for Supervision
and Curriculum Development

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Introduction

OUT OF the morass of modern curricular and instructional innovations of every cast and variety, teachers and supervisors are asked to make some selective decisions. They feel at a loss in trying to make these educational decisions, because the new programs and instructional devices do not seem based on consistent undergirding theories of instruction. Stated or implied theories range all the way from vague talk about open-ended discovery method to precise statements about operant reinforcement.

Further, the publicity and financial support given to the implementation of technological change, in the absence of clear-cut research evidence or clear theoretical rationale, add to the confusion which besets education. Teachers and supervisors in the field miss the reassuring dicta of the progressive educators who were able to give them one oversimplified instructional focus, "involvement." Those who were persuaded more by the Thorndike approach felt secure in its "laws of learning" as guides for devising methodology. It is no wonder that school people brought up on the teachings of Kilpatrick or Thorndike find it confusing when they are faced by so many curricular and instructional propositions, for they simply are not prepared for the fluid situation of today. They are neither able to develop an eclectic orientation, because of the many contradictory statements being made, nor to develop any consistent, data-based view of instruction.

They feel there must be a new theory of instruction they do not know about. And if there is not one, they think somebody ought to get busy making up one. This latter demand may be one of the reasons behind the pressure on the Commission to derive a theory or at least two or three valid theories of instruction from the mounting data gathered from the investigations of the teaching act.

The ASCD Commission on Instructional Theory, early in its discussions, decided against attempting to develop a theory or theories since that is the task of the scholar-scientist. Theories are not built by committee. The task of scientific theory building is a long, hard, full-time job, usually done in relation to ongoing investigation.

A theory grows from the process of experimentation as investigators "play around" with new data in the light of earlier conclusions. Hunches are intuited from the study of new relationships and formulated into hypotheses for testing in further instances. As hypotheses become validated they lead to systems of theoretical propositions and are labeled theories. Theories are always open to review. Propositions are constantly being modified as the results of further experimentations are related to the theory. When the modifications begin to overwhelm the theory, then new theory is proposed.

Given this concept of theory building, the Commission is not an appropriate agent for generating theory. It is, however, an appropriate body to look at the process of building theory about instruction and to offer some criteria for assessing proposed statements of instructional theory.

We believe such criteria will be useful to the curriculum worker in evaluating new curricular programs. The guidelines will give such workers a means for extrapolating theoretical propositions from educational statements. The guide will offer criteria for assessing the validity of theory, which is usually stated in simplified form as part of the exposition of an educational program.

A curriculum program usually includes an ordered set of tasks to be undertaken for the achievement of goals. This part of curriculum building is the *pre-active* state of planning. But such curriculum guides usually recommend strategies for instruction. At this point the program developers are concerned with the *interactive* aspects of instruction. Psychological theories for involving teachers and pupils in the educative process have to be invoked. It is at this stage of educational planning that more prevision based on theory assessment needs to be injected into the development of such programs.

Proposals for such systems as computer-assisted instruction must also be carefully examined and analyzed to see what are the implicit or stated postulates about the nature of the instructional act. It is not enough to rest on such clichés as "individualized instruction" or on the glamour of the gadget. These guidelines, therefore, are offered in the hope that people charged with the responsibility to create curricular or instructional systems, or to determine their use in the schools, will use these guides to assess their work. Further, we hope that researchers will find in these criteria stimuli to theory building and to continued investigation.

Instruction is a complex phenomenon, and we hope that our endeavor will lead educators to prize its complexity, to develop a variety of sub-theories, and to avoid the simple solution and emotionally satisfying answer. The term *sub-theory* is used here to denote a limited theory that pertains to a narrow aspect of classroom events. A series of statements concerning what is known about conditions that are favorable and unfavorable for the teaching of reading would, in essence, constitute a sub-theory of instruction pertaining to

reading. Other sub-theories can be developed in other areas of instruction where considerable empirical knowledge has accumulated.

We have become aware of the gaps in our knowledge and in our theories. We hope the use of these criteria will spread this awareness. Indeed, we found it difficult to locate good examples of theory statements which meet our guidelines. We assume the difficulty is not in our guides, but in the state of development of education as a science. We hope that all who read this paper will be more careful in applying the word "theory" or in accepting as scientific theory what may better be called by other names, such as "philosophical position" or "social point of view."

This paper represents a beginning. It offers the challenge of careful assessment, logical analysis, and empirical pursuit of understanding of that which is central to our task: instruction.

1

A Concept of Theory of Instruction

THE TERM *theory* has many common meanings both within and without education. Since our concern here is with *theory* of instruction, an appropriate beginning is a consideration of the various meanings of the term *theory* and the identification of the term as it is used here.

Uses of the Term, *Theory*

The commonest usage of the term is in the context of ordinary speech in which communications often begin with the announcement, "I have a theory that . . ."—an announcement that is typically followed by an attempted explanation of some event that has happened.

Much the same kind of usage is found in the statement of a teacher who says, "I have a theory that Johnnie would do much better work if he were to go to bed earlier." In this sense of the term, a theory is a speculation, a kind of hypothesis concerning why something happens. The statement involved is not a result of detailed inquiry but, perhaps, suggests a position at which inquiry might begin.

A rather different usage of the term is found in the brief speech of a member of a board of education who began, "I want to tell you about my theory of education." The speech that followed such a preface showed that the term *theory* was used to denote a plan of action (for the teacher). These are some of the common usages of the term *theory*.

There are other technical usages of the term. In mathematics, the term *theory* is also widely used but with an entirely different denotation from the common language usage. Mathematical books bear such titles as "Theory of Numbers" and "Theory of Sets." In these titles, the term refers to a system of

interrelated propositions that have been derived deductively from a set of axioms.

The propositions do not have to have any relationship to a real world as we know it in our daily lives. Indeed, mathematicians can derive sets of propositions which could be descriptive only of a universe with different properties from our own, as is the case with some advanced geometries. The essence of the meaning of theory in this context is that it relates to a system of interrelated propositions. The term *system* could perhaps be used instead, but the term *theory* has been used by generations of mathematicians and represents the established usage of the field.

Philosophical and Humanistic Theory

The word *theory* is also used by philosophers and scholars in the humanities to refer to consistent and logical formulations about man's place in the world. Theory of this kind is composed of sets of assumptions or considered beliefs derived from a scholar's personal experience in the world and his contemplation of it in relation to the studied experience of others. The scholar or writer develops an outlook by which he views man and attempts to explain his existence. Plato's theory of the ideal and the many propositions derived from it is an example. Milton's description of man's relation to cosmic forces in *Paradise Lost* and *Paradise Regained* is an elaborate construction of humanistic theory.

A tenet of existentialism states that man must be "engaged" actively with his world, otherwise he will become detached and isolated, thereby losing his humanity. The theory of "engagement" has ethical power but does not lend itself to scientific validation. It is representative of another domain of theorizing equally as important to the understanding of man as is scientific theory. Much of past and present day educational theory is of this humanistic type and it holds a prime position in the study of education.

Scientific Theory

The natural sciences show extensive use of the word *theory*, but little uniformity in the situations to which the term applies. Chemists use atomic theory to explain the fact that substances are composed of a limited number of different kinds of particles. Although the term *atomic theory* evolved during the eighteenth century, at which time it could have denoted a plausible hypothesis, the same term is now applied to a body of empirical information. However, the term *atomic theory* is also applied sometimes to conjectures about the structure of the atom and, in this sense, is synonymous with *theory of nuclear physics*.

In its most frequently found form in the natural sciences, the term *theory* refers to a set of propositions inductively derived from empirical findings. Thus the kinetic theory of gases, at the time at which it was derived, was represented by a set of propositions such as the following:

All gas consists of particles that are in continuous motion. The impact of the particles on the walls of the container produces the pressure exerted by the gas. An increase in temperature increases the mean velocity of the particles.

The propositions of the theory were introduced as conjectures to account for a great range of empirical findings, and, in a sense, were also derived inductively from these findings. For example, the propositions lead one to expect the finding reported by numerous physicists of the last century that as gas is evacuated from a flask the pressure becomes reduced. The theory is introduced to provide a basis for understanding this finding as well as many other findings.

The form of theory represented by the kinetic theory of gases is the typical form which theory assumes in the natural sciences. It is a set of generalizations inductively derived from empirical findings. The propositions are conjectural in that they go beyond both the data and the empirical generalizations on which they are based. They represent an interpretation of the data and draw whatever validity they may have from their consistency with the data.

Theories survive if they have utility, in some sense of the term. A necessary condition for utility is that deductions can be made from them and that these deductions can be demonstrated empirically to represent true propositions. Thus one can deduce from the kinetic theory of gases the rates of chemical reactions, and these deductions have been experimentally demonstrated to be true.

Instructional Theory

In this document the term *theory* is used as it is used in the natural sciences to represent a set of interrelated generalizations derived from data, which permit some degree of prediction or control over the phenomena to which they pertain. Thus a *theory of instruction* would be represented by a set of statements, based on sound replicable research, which would permit one to predict how particular changes in the educational environment (classroom setting) would affect pupil learning.

In this document the word *instruction* refers to the activity which takes place during schooling and within the classroom setting. The term includes both material and human variables. Instruction is differentiated from teaching in that instruction encompasses more of the situational elements. Teaching refers primarily to the human interaction between teacher and pupil.

The Development of Scientific Theories

About three and a half centuries ago physical science adopted the Galilean model. During this period, the discipline emerged from the domain of philosophy to physical science. In the Galilean model, terms are defined and their interrelationships are described quantitatively. Hypotheses are stated so that they can be clearly verified or refuted by means of empirical data.

Pertinent empirical data are collected under controlled conditions, or experiments. Simple experiments are regarded as best since the effects are more clearly demonstrable and controls more readily achieved. However, the method is not a rigid set of procedures that can be taught to students, but involves infinite variation in the hands of scientists. The method often blends with intuitive procedures.

This method produced knowledge that has remade our physical world and given us control over the physical aspects of our environment. It has been held up as the ideal way of undertaking scientific inquiry. It has been copied by virtually all areas that aspired to become sciences. The method works best in physical science—it is most easily and most precisely applied there. Experimental control, testing of hypotheses, and statement of simple hypotheses are most directly observed there. In physical sciences, whenever the experiment is repeated, results are comparable.

Social and behavioral sciences, including education, have adopted the physical science model as their ideal. But, there are some very real complications—dependable quantification is not as readily achieved, terms are not as easily defined, and their interrelation is not as adequately expressed in precise quantitative terms. Experimentation, or control of the variables involved, is not as rigorous. The study of social and educational phenomena is often more like astronomy, which must be done by observational rather than strictly experimental approaches.

What the model offers us is a view of the precision in measurement and definition which we need to achieve in our theory building in instruction. Some of our research designs and techniques will not, and do not need to, resemble a physics model, but they do need to be as precisely stated. For this reason we have chosen to use the model in spite of the recognition that it does not quite fit education. It does indicate a direction toward precision in theorizing about instruction which we believe is required.

2

Instructional Theory— Looking Backward and Forward

DOCUMENTS that have some claim to present a theory of instruction vary from sets of speculations (the speculations range from those that have no data to support them to those that are stated in a form which makes them unverifiable) to attempts to provide comprehensive presentations. Most such statements were produced long before research had reached the point at which it could provide the kind of evidence that a theory in the natural science tradition should have to validate it.

A theory of instruction, such as that of Maria Montessori, was developed in an age when almost all the data available were those derived from personal observation in classrooms. However, one must give Montessori credit for searching out and bringing together the evidence available in her time on which a theory of instruction might be built. John Dewey's work on "interest and effort" is another example of using personal observation to lead to postulates. This procedure was appropriate for its time. The work of both Montessori and Dewey can now be carefully studied, hypotheses can be stated and investigations made to test many of their ideas.

Many contemporary theorists living in a data-cluttered world have, in contrast, made little effort to derive their theory of instruction from the information at hand. Indeed, some of those who have preached doctrines related to discovery learning and inquiry learning seem guilty of attempting to build theories of instruction without utilizing currently available knowledge. Our position here is that contemporary data-free theorizing represents a kind of schizophrenia which, enjoyable though it is, is likely to be on the way out.

The scientific schizophrenic lives in a world of words unrelated to reality. He claims to be something he isn't. He takes position without evidence, or

in spite of evidence. He sees evidence as irrelevant, or as unobtainable, or as usable only to support already held positions.

The Future of Instructional Theory

Our position is that, from this time on in education, theories of instruction will have to be related to scientific data rather than only to data from personal experience. Such theories will consist of propositions relating conditions of learning to the extent to which objectives are achieved. Terms of the statements representing the theory will have to refer to variables that have been demonstrated to be related to the achievement of various objectives including pupil characteristics, task characteristics, and teacher characteristics.

One may well suspect that, for a long time to come, the main sources to which teachers will turn for guidance will not be the kind of scientific theory considered here. One may well be reminded that, at the turn of the present century, weather prediction undertaken by rule-of-thumb procedures is said to have provided a better basis for predicting the weather than the scientific theories of the meteorologist.

Often, in the early days of the development of a scientific area, folklore typically provides a better basis for guiding behavior than scientific theory. However, history shows that once substantial effort has been devoted to the development of an area of knowledge, scientific means of prediction and control rapidly surpass those which tradition has provided. It is our opinion that the same will be true of education and that when persons in education become active in building theories of instruction in the tradition of the natural sciences, the power of the theories that are developed will rapidly surpass the rule-of-thumb approach of the layman or the practitioner.

Theories of Instruction and Values

Writers of the past who have claimed that they were presenting a theory of instruction have generally begun their discourses with a presentation of the values that they believe education should achieve. This has been followed by a description of the procedures that the particular writer believes to be effective in achieving the values. Such writings present a combination of beliefs and values, but do not typically present a theory of instruction in the sense in which the term is used in this document.

We would consider a useful theory of instruction to represent a statement of empirically established ways of achieving a great range of different goals. The user of such a theory would have to decide what goals he wished to achieve, and he could then consult the theory to determine what had been

established as the best ways of achieving his goals. The theory of instruction itself would not specify what goals should be achieved and, hence, could be used by those who subscribed to fundamentally different educational philosophies. The theory would be value free in the sense in which Newtonian physics is value free.

There is, of course, a sense in which all scientific theories incorporate implicit values. One presumes that Newton became involved in problems of motions because he believed that this was a worthwhile area for study. Again, Kepler would not have concerned himself with the study of the motions of celestial bodies if he had not thought that these were worthy objects for study. A scientific theory implies that a judgment has been made concerning the worth of the scientific enterprise. Thus a theory of instruction exists because one or more persons have judged this to be a worthy enterprise for occupying their time. The inclusion of such implicit values does not mean that the theory is going to determine educational values of the future.

A more serious source of value bias in any theory of instruction that is likely to emerge is derived from the bias inherent in the research which relates conditions of learning to outcomes. Much of the research that has been undertaken on instruction involves the relating of learning conditions to outcomes as measured by tests.

Thus a theory of instruction, based on empirical research, might have much more to say about how to teach simple knowledge than how to teach problem-solving skills, and hence bias those who consulted it into thinking that the acquisition of knowledge was more important than the acquisition of problem-solving skills. This kind of biasing effect would not be a result of the theory having been built on a particular set of values, but a result of the limited knowledge available on which the theory had to be based.

Relationship of Theory to Data

Scientific theories are, necessarily, empirically based. For each statement in the theory there must be data from which it is derived and the data must be reproduceable and incontrovertible. The data are linked to the propositions that present the theory through a set of protocol statements that precisely summarize the data. The results section of any scientific paper includes at least one protocol statement which summarizes the empirical findings. A statement such as, "The data from this experiment showed that the simultaneous transmission of the verbal information through both the eye and the ear did not produce significantly more learning than when the information was transmitted through the eye alone," is an example of a protocol statement.

Protocol statements must have a precision which places them largely above dispute before they can be used as the foundation for deriving theoreti-

cal statements. If an experiment has been replicated or if it has been reproduced with some variations and the resulting protocol statements are essentially similar, then these could be used as the basic data statements on which a theory might be built. If, for example, a study reported that "those children in the group which received a high frequency of rewarding statements from the teacher learned significantly more (p. 001) in terms of the test administered than those children in the group receiving a low frequency of rewarding statements," then this statement becomes of value in constructing a theory if it is similar to other statements derived from other experiments.

In order to be of value as a protocol statement, there must also be no doubt about what is meant by the terms used. If the study lacks any definition of what is meant by a "rewarding statement" then it cannot be used as a protocol statement, if only for the fact that it does not provide a basis for comparing the results of this study with those of others. If two studies involve fundamentally different definitions of the term "rewarding statement," then the results cannot be easily correlated if they can be correlated at all. Lack of comparability between the defining statements used in different studies to define the terms in the protocol statements is a common problem in studies that involve classrooms. This is much less of a problem in experimental research in the laboratory, where the apparatus available defines the situation with considerable precision.

The lack of uniformity of the situations in which classroom studies are typically undertaken often results in the use of a language in which the terms do not refer to well-known defining situations. The result is an ambiguity in the protocol statements and a very serious limitation in the extent to which such statements can be used for the construction of a theory.

Suppose that a study reports that pupils, working in pairs, were rewarded with teacher approval for cooperating. The study further states that the term *teacher approval* includes any approving statement or gesture made by the teacher indicating approval. This definition approximates an operational definition in that it refers to a category of behavior that can generally be identified. One can reasonably assume that a smile on the part of the teacher would be included in the category of teacher approval, but how transitory or fleeting can a smile be before it is no longer placed in the approval category? Again, a clear comment of approval such as "that's very good," falls in this category, but how does one classify a statement such as "what you have done is a little better than the worst I have seen"?

Most attempts to provide operational definitions of terms by alluding to educational situations do not provide completely unambiguous statements concerning what events do and do not fall within the defined category. Completely unambiguous operational definitions of basic terms are rarely found outside of the experimental sciences. Rigorous experimentation presents few

problems in this respect. There is little ambiguity in the statement that each child in the experiment was rewarded for each correct response by the delivery of a marble from a Briggs Manufacturing Company Marble Dispenser. The definitions of terms used in communicating educational research lack the precision of definition achieved in experimental sciences, but the level of precision can still be vastly better than it has been in the past. *A theory of instruction can be no more clear and unambiguous than the protocol statements on which it is based.*

Technical Language

The protocol statements are generally communicated in a technical language in which all key terms are operationally defined. In this respect the language of the protocol statements differs from the technical language utilized in the statement of theory, in that the latter technical language involves the use of theoretical terms which cannot be directly operationally defined. The requirements of a technical language in the behavioral sciences have been well explored by Mandler and Kessen.¹

The propositions of a theory must be consistent with the *body* of empirical evidence available. The practice has been all too common in educational circles of citing a particular study as supporting a particular position, but without taking cognizance of the fact that there are other studies which support an opposite position. The single study by itself cannot be considered to have implications for practice because so many studies, produced in the context of education, do not yield the same results when they are replicated.

The generalizations included in a theory must be based on studies which have been replicated with substantially similar outcomes. This does not mean that one can use only that evidence which is uniform across studies, for in almost any area of behavioral research where much research has been undertaken, there are always some studies that produce results out of line with the main body of evidence. These studies, with results that are out-of-line, often reflect inadequacies in the techniques of those who carried them out. Some research workers are more meticulous than others, and this fact is reflected in a lack of complete uniformity of results from research within a limited area.

There are areas of research where the majority of studies do not provide results pointing in the same direction. Some of the research on anxiety in relation to learning is of this character. Such research cannot be used as a basis for theory construction.

¹ George Mandler and William Kessen. *The Language of Psychology*. New York: John Wiley & Sons, Inc., 1964.

Components of a Statement of Theory

A theory in the natural science sense considered here can be analyzed into a number of distinct classes of component statements. The two main classes involved are those statements which define terms and those statements which represent relationships between terms. The latter class of statements represent the core of the theory while the definitional statements simply make it possible to understand the terms used in the theoretical propositions.

The terms of a theory can be conveniently thought of as belonging to three main classes. First, there are those that may be referred to as *primitive terms*. These cannot be operationally defined. Every theory includes some such terms. Second, there are *key terms* which can be and must be operationally defined. Third, there are *theoretical terms* which cannot be defined directly by referring to identifiable operations but which can be defined through the use of terms which can be operationally defined. The propositions which define the theoretical terms can be thought of either as belonging to the core of propositions that represent the theory itself or can be classified among the defining statements. Let us consider each of these three classes separately.

Primitive Terms

Early writers on the philosophy of science may have taken the position that all terms should be, and could be, operationally defined. However, it became evident with the passage of time that some terms cannot be defined either through reference to operations or through reference to other operationally defined terms. These are the primitive terms of a theory. In education, many terms such as "felt needs" fall into this category. Additional examples are *purpose* and *experience*.

In Euclidean geometry, the concept of a *point* or a *straight line* represents two such terms which play key roles in the development of the conceptual systems. If a statement is made that "an explosion occurs *after* the ignition of a mixture of X and Y," then the word *after* would be classified as a primitive term. The term *after* is understood in terms of direct *personal* experience and does not represent a publicly observable event. *The introduction of some primitive terms is inescapable in the construction of a theory, but these terms must be kept to a minimum.*

A theory of instruction could be written almost entirely in primitive terms, but there is doubt whether such a theory could have any utility at all. Indeed, there are currently available theories of instruction which are highly loaded with primitive terms. Such theories have virtually no utility because they do not refer to anything publicly observable. Indeed, such theories appear to serve far more the role of presenting affirmations of belief and value

rather than those of guiding action. They represent statements concerning matters which can be only intuitively experienced. Thus a theory of instruction, developed in the scientific tradition, would involve a minimum of such terms. Certainly, much that is referred to today as theory of instruction suffers from a vast overabundance of primitive terms.

Key Terms

A key class of terms in any scientific theory is that which includes all terms which can be, and must be, operationally defined. Any of the categories of behavior commonly mentioned in educational studies must meet the requirement of being backed by an operational definition. Thus terms such as *reinforcement*, *aggression*, *problem solving*, *inquiry*, *rote learning*, *word difficulty*, and numerous other commonly used technical terms, all have to meet the requirement of having behind them adequate operational definitions. This is not as easy as it sounds. Operational definitions are generally provided in the experimental sciences in which each term can be defined in relation to events in standardized experimental situations.

Again one is reminded that machines deliver marbles as rewards in precisely the same way on every single occasion when they are operated, but teachers do not administer reinforcement with the same invariance. In addition, one can readily check whether an allegedly reinforcing event is changing response probability in a child in an experimental situation; yet the same check cannot be so readily made when attempts are made to reinforce pupil behavior in the classroom. Some scientists are sufficiently discouraged about conducting educational research in classrooms, because of the basic difficulty of defining terms, that they have even suggested that such research should be abandoned. At best, the operational definition of terms in educational settings lacks the objectivity and precision which Bridgman² had in mind in his writing on the subject. The defining of terms through classroom operations represents a most serious limitation on the development of theories of instruction at the present time. If basic terms are not clearly defined, then one cannot expect to achieve much in the direction of clear conceptualization.

The importance of defining terms operationally has long been stressed in education, but often without an understanding that a term cannot be justified merely by the fact that it is operationally defined. Bergman³ has long deplored the practice of defining operationally terms which have virtually no value for representing knowledge and which do not lead to the statement of useful propositions. Adding a person's height in inches to his weight in pounds

² Percy W. Bridgman. *The Logic of Modern Physics*. New York: Macmillan Company (paperback reprint), 1946.

³ Gustav Bergman. *Philosophy of Science*. Madison, Wisconsin: University of Wisconsin Press, 1957.

and calling it a measure of a *size factor* does not help to define a useful scientific term even though the definition is faultlessly operational.

If an operationally defined term is to have value, it has to form part of a scientific system of terms which can be used for writing meaningful propositions. The basic terms of physics such as *force*, *mass*, and *acceleration* are highly useful terms in a scientific system because they can be used to write such propositions as, "The acceleration of a body is proportional to the force exerted on it," and "When a given force acts upon a body, the acceleration of the body will be proportional to its mass." The fact that such statements can be written reflects the fact that the three operationally defined terms belong to a system. *Key terms must be operationally defined and belong to a system of ideas.*

Theoretical Terms

Theories with any degree of sophistication introduce theoretical terms. These cannot be defined directly by pointing to particular events, but are defined through their relation to other terms which are operationally defined. Almost any discussion of learning involves the introduction of theoretical terms such as *motivation*, *cognitive dissonance*, *response hierarchy*, *cognitive strain*, *attitude*, *set*, *perceptual structuring*, and so forth.

Consider a statement such as this: "Depriving preschool children of opportunities to interact with others raises their social needs which result in adult approval becoming a more powerful reinforcer of behavior." In this statement a theoretical term *social need* is introduced and is defined by the way in which it relates to an operationally defined condition of deprivation and to an operationally defined consequence, namely, the reinforcing value of adult approval. This is the form of statement in which theoretical terms are introduced into a theory. Such statements may be referred to also as theoretical propositions.

Language Problems in Instructional Theory

Communication through the use of a technical language developed around the behavioral sciences is limited, not only by the fact that the definitions of the terms still allow a certain degree of ambiguity, but also because the language still involves many basic defects. Although the psychology of learning has developed a highly sophisticated technical language, the language is still only an approximation to the communication tool needed by an advanced science.

For example, in current literature the term *reinforcement* is used sometimes as an empirically defined term and sometimes as a theoretical term.

When the term refers to an objectively identifiable event, such as the delivery of a marble to a child, the term is being used as an empirically defined basic term. However, in many studies such as those involving the social reinforcement of the behavior of children after they have been deprived of social contacts for a period, the term *reinforcement* is used with the implication that the social reinforcing event is somehow related to the need of the child. *Reinforcement* used in this connection is a theoretical term.

Generalizing in Theory Building

The central core of the theory itself consists of a set of propositions, that is to say, statements which represent the knowledge that the theory encompasses. Some of these propositions represent empirical generalizations and do not include the introduction of theoretical terms, while others are likely to be theoretical statements—that is to say, statements that include theoretical terms.

Empirical generalizations are those derived directly from protocol statements. For example, there is a considerable volume of research which leads to the generalization that "An increase in the aversive behavior of the teacher results in a reduction of the rate at which elementary school pupils learn." This is an empirically derived generalization closely tied to the outcome of many studies. (Let us assume that the key terms of this generalization have been operationally defined.) The statement does not include any theoretical terms. Another example of an empirically derived generalization is the statement, "The introduction of irrelevant dimensions in concept-learning tasks reduces the rate at which the learner acquires a concept."

Some of the statements representing a theory of instruction would, almost certainly, have to be theoretical statements and involve theoretical terms. A statement such as, "An increase in the motivation of the pupil results in increased vigor with which the learning activity is engaged in," involves a key theoretical term "motivation." The statement, as it stands, does not say anything about how motivation is to be manipulated by the teacher, neither does it imply that rate of learning becomes more or less rapid as the level of motivation of the pupil is raised. Such matters would have to be stated in other propositions of the theory.

Theory Forms

The form of theory with which we are concerned here is one which must permit empirical verification of the postulates.

Whenever a field is as highly developed as physics and mathematics, it sometimes is possible to use the axiomatic deductive method to derive re-

sults that have not yet been observed in the real world. This method is in several respects different from the more empirically based procedures of the Galilean method.

Thus, in the earlier stages of physical or natural science, theories must be such that they can be empirically validated. As their fund of dependable knowledge increases, it appears to be possible to obtain results of increasing generality until it becomes possible to use an axiomatic deductive approach. In the earlier stages of science, including physics, empirical validation represents a significant step in the direction of increasing knowledge. Educational research, which is at present in the early stages of development, now requires empirical validation. In the future, educational research, too, will move toward the axiomatic method.

Validation of Theories

Many statements in contemporary educational literature that claim to be, in some sense, theories of instruction are expressed in terms that exclude empirical validation. For example, a commonly stated theory of instruction has, as its core proposition, a statement that free creative expression in the classroom results in self-actualization. The fact that the terms are not pinned down virtually eliminates the possibility that evidence could be found to validate this theory. Those who hold such a belief are faced with the task of clarifying what is meant by "free creative expression" and "self-actualization." Until these terms are clearly identified, this proposition is not acceptable from the point of view of our use of the term *theory*.

While the ultimate validation of theories of instruction must be undertaken through empirical research, statements of theory can also be examined in terms of the degree to which they reflect certain formal properties as theories. One can list some of the formal properties that theories must possess in order to permit empirical validation. A list of such formal properties is presented in the next chapter.

Criteria for Evaluating Theories of Instruction

The criteria for evaluating the formal properties of theories of instruction presented in the next chapter serve two main purposes. First, they can supply a guide for those interested in building a theory of instruction by indicating the formal properties that the theory should provide. Second, they provide a basis for reviewing theories of instruction that have been built and that will be built in the future.

Let us consider the first of these. One of the problems encountered in the development of a theory of instruction in the past is that there has been no

guide available to indicate what such a theory should or should not include. The criteria provided here represent some of the necessary conditions that a theory should represent, but the satisfaction of all of these conditions does not mean that the theory is satisfactory. The criteria reflect *necessary* conditions and not *sufficient* conditions for a satisfactory theory.

The Commission also believes that the criteria are realistic in that they represent conditions that can be satisfied by the conscientious theory builder who is willing to attempt to build a theory in a limited area of instruction. *Theories of instruction no longer have to be pipe dreams divorced from data.* They can be built on a solid foundation although they may be limited in scope. They do not have to be only affirmations of faith but can represent the fruits of the development of substantive knowledge that has been derived from research.

The second use of the criteria is that of providing a guide to the evaluation of theories of instruction that have already been developed. Many of those that have been developed in the past, derived in the tradition of the humanist rather than that of the natural scientist, probably should not be evaluated through the use of the criteria. Just how they can be evaluated is problematical. Yet, unless there are criteria available for evaluating theories, how can one ever determine whether one theory is more promising than another?

The Commission regards the criteria as representing, collectively, an instrument which persons working in academic institutions and in curriculum projects may be interested in using. The instrument is not appropriate for a teacher concerned with evaluating his own personal theory of teaching, for it is designed to be applied to theories that are empirically based and which meet certain minimum formal requirements.

3

Criteria for Assessing The Formal Properties of Theories of Instruction

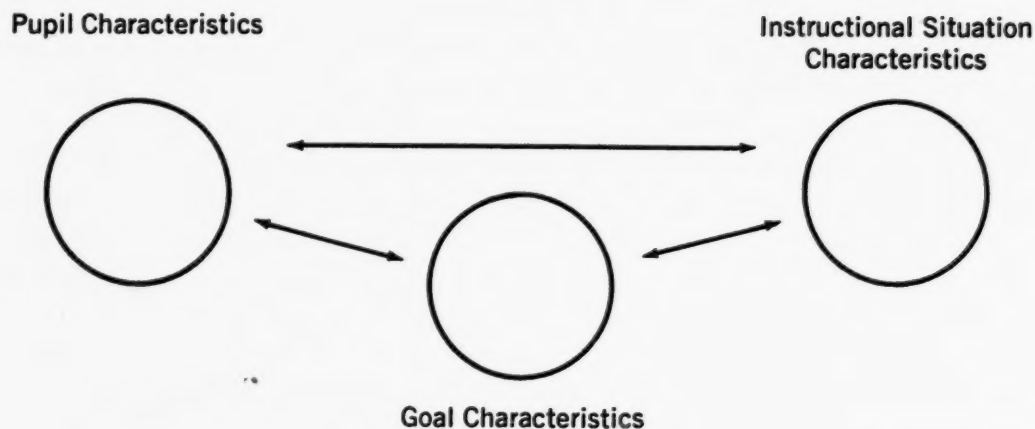
THE CRITERIA presented below include those which apply to the analysis of any scientific theory. They have been made particularly applicable to instruction through the illustrative material. For convenience, they are presented in outline form.

I. A statement of an instructional theory should include a set of postulates and definition of terms involved in these postulates. Pupil, goal, and instructional situational characteristics should be operationally defined. The theory should include a minimum number of primitive terms which cannot be defined ("experience," "awareness," "real self," "process").

The diagram on page 17 indicates the network of interrelations between pupil, instructional situation, and goal characteristics. Each of these sets of characteristics needs to be explicated.

A. The pupil characteristics must be specified together with the relationship they have to the goals. The characteristics must be demonstrated as related to learning. If one is developing a theory of reading instruction for sighted pupils, visual form discrimination is a relevant variable; if one is developing a theory of instruction in reading for blind pupils, tactile two-point threshold (at the finger tips) is a relevant variable. The following are some of the dimensions of pupil characteristics which could be specified:

1. Biosocial variables: age, sex, social class, level of physical maturity



2. Psychological variables: level of intellectual development, academic achievement, cognitive style, self-concept, achievement motivation.

B. The characteristics of the instructional situations must be specified together with the relationship they have to goals. For example, if the goal is the ability to ask questions, then the situation should involve practice in questioning. However, the relationship need not be logical, but must have some rationale. Ability to play scales on the piano rapidly relates to practice, but practice focusing on accuracy, done slowly, rather than speed. The following are some of the dimensions which could be specified:

1. Organizational variables: time, space, class size, class composition
2. Content variables: tasks, media, sequence
3. Teacher behavior variables: acts the teacher is directed to perform, management techniques
4. Teacher personality variables: warmth, openness, control, style.

In addition, the characteristics of the instructional situations must be specified together with the relationship they have to pupil characteristics. In learning an abstract concept in science, for example, the younger the child, the more the abstract terms of the concept have to be derived from concrete situations. A child cannot be expected to master an abstract idea before the concrete groundwork has been laid.

C. Goal characteristics should be dimensionalized. That is, objectives should be described in terms of change with respect to specified dimensions. The outcomes should be specified along a scale. These outcomes are describable as performances on a task. For our purposes, a task specifies the kinds of actions which have to be undertaken to reach a goal. In economics, for

example, the task may be to handle the variety of equations utilizing the concepts of C for consumer, I for business investment, G for government, F for foreigners, and the sum of these, GNP, Gross National Product. In Suchman's work using "discrepant event," a task is to ask questions; a goal is to learn how to ask questions.

An objective might be that a child would read each month one book of his own choice from the school library, or the objectives could be multidimensional. For example, at the end of period X of time, a given child should be able to read Y type of material, at a given level of speed with a stated level of comprehension.

Again, it must be stated that these objectives must take into account pupil variables, so that the economics task may be specified for pupils of a given age, level of achievement, etc., rather than necessarily being for all children.

An illustration of the relationship between pupil characteristics and goals may be drawn from The Joint Council on Economic Education Program.⁴ The statement of the Council's goals for the elementary level gives an indication concerning the nature of the child. It holds that:

The main purpose of economic education in a free society is to develop the problem-solving ability of our children as it relates to personal and social problems, basically economic in nature. To accomplish this purpose we must:

1. Develop the child's analytic ability
2. Help the child relate his everyday experiences to the big world around him.

Even a first-grade child has economic decisions to make.

The child is thus seen as a problem solver, and, more than that, someone who is concerned with utilizing academic concepts to handle his daily needs. "It is important that elementary teachers, supervisors, and school administrators take full advantage of the intellectual curiosity of children. Children are yearning to be identified with the world around them. They should be given that opportunity" (p. 19). A cursory view of the various ideas and concepts to be developed at the elementary, junior, and senior high levels indicates a belief in development of the child from someone who can deal with materials only at a concrete, highly personalized, immediate perception level to a youngster who can relate abstract concepts to other abstract concepts, who can analyze "big ideas," who can engage in the utilization of abstract symbols.

D. A change in pupil characteristics leads to change in instructional situation characteristics. A theory needs to specify how, as pupils progress toward goals, the instructional situation has to change. For example, as the

⁴ Joint Council on Economic Education. *Teachers Guide to Developmental Economic Education Program*. New York: the Council, 1964. Copyright © 1964 Joint Council on Economic Education and reproduced with their permission.

pupil masters vocabulary, the level of vocabulary used should change. This may be expressed as follows:

$$P_c = f(I)$$

Pupil change is a function of instruction

$$\Delta P_c = \Delta I$$

Increments in pupil change are related to changes in instruction.

The relationships among goal characteristics, instructional situation characteristics, and pupil characteristics may be seen in the work of Montessori.⁵

In defining her goal of educating the senses, Maria Montessori states that the aim is "the refinement of the differential perception of stimuli by means of repeated exercises" (p. 173). One dimension of this goal is to educate the eye to the different perceptions of dimensions (p. 169). The young child notes different dimensions of solid geometric forms and compares various sizes. He "observes the relationships between the size of the opening in a mould and that of the object which he is to place in the mould" (pp. 100-170). This aspect of the goal of sense education is achieved when the child correctly places the solid geometric forms in the appropriate moulds.

She describes the teacher's role and the didactic materials. The directress makes a pedagogical experiment with a didactic object and awaits the spontaneous reactions of the child (p. 167). The child is caused to exercise the senses (p. 168). With little children, the directress must proceed to the making of trials, and must select the didactic materials in which they show themselves interested (p. 168). The directress presents didactic materials made up of graded stimuli. These provoke auto-education (p. 169).

The didactic object is a block in which solid geometric forms are set.

Into corresponding holes in the block are set ten little wooden cylinders the bases diminishing gradually about three millimetres. The game consists in taking the cylinders out of their places, putting them on the table, mixing them, and then putting each one back in its own place (p. 169).

If he mistakes, placing one of the objects in an opening that is too small for it, he takes it away, and proceeds to make various trials, seeking the proper opening. If he makes a contrary error, letting the cylinder fall into an opening that is a little too large for it, and then collects all the successive cylinders in openings just a little too large, he will find himself at the last with the big cylinder in his hand while only the smallest opening is empty. The didactic material *controls every error*. The child proceeds to correct himself, doing this in various ways. The normal child always repeats the exercise with growing interest (p. 171).

⁵ Maria Montessori. *The Montessori Method*. New York: Schocken Books, Inc., 1964. Reprinted by permission. Schocken Books, Inc.

Pupil characteristics which Maria Montessori recognizes, and which might be stated as postulates, are:

1. Little children of two or three years take the greatest pleasure, a spontaneous lively interest, in arranging objects.
2. The young child can perfect himself through his own efforts and without teacher intervention. He is capable of auto-correction and auto-education.
3. Learning proceeds first by perceiving objects and then by understanding motor activities in relation to the objects.
4. Effective use of the senses requires that they be educated.
5. The education of the senses precedes the learning of the names of sensory attributes.

Although these postulates may lack adequate empirical support in contemporary psychology, they illustrate the type of statement which needs to be made in a theory of instruction.

Ausubel's⁶ derivatives from Piagetian theory, in which Ausubel postulates that when pupils reach the formal operational level of thought they can be instructed more didactically, is another example. Gagne's⁷ steps in learning are more formal examples of sequence.

II. The statement of an instructional theory or sub-theory should make explicit the boundaries of its concern and the limitations under which it is proposed. Theories can be so generally stated that they lose relevance by trying to incorporate the universe. For example, when a theory of conditioning is stretched so far as to include not only psychomotor learning but also literary production, the S-R representation becomes complex to the point of absurdity. It is not a useful theory for predicting such a phenomenon and should be limited to smaller step-like aspects of learning in which conditioning can be plotted within observable boundaries.

An instructional theory which postulates that being taught by a discovery method will produce inquiry in the children should specify:

- A. A limited goal, the special type of inquiry to be gained by the children
- B. A particular group type of children, their age and similarity of cultural-social background

⁶ David P. Ausubel. *The Psychology of Meaningful Verbal Learning*. New York: Grune & Stratton, Inc., 1963.

⁷ R. M. Gagne. *The Conditions of Learning*. New York: Holt, Rinehart & Winston, Inc., 1965.

C. A defined instructional situation, materials and the way they are to be used in open ended or directed fashion.

A theory of teaching inquiry could be overly general if it did not, for example, make a limiting statement about the developmental characteristics of the pupils. Discovery strategies that stress formal logical abstraction are not likely to apply at earlier levels where concrete operational thinking is more likely to occur. Teaching inquiry becomes as meaningless as teaching to satisfy children's needs when globally stated.

The way "need theory" is used in many educational circles is a prime example of meaningless generalized explanation that comes from speculating without stating limits or boundaries. In any event, what is proposed must be encompassed by a description of bounds or the theory begins to leak either because too many factors become uncontrollable or because the theory has to be stretched beyond reason to embrace the growing examples of deviant phenomena.

III. A theoretical construction must have internal consistency—a logical set of interrelationships. If a theory has a postulate that the control of learning resides within the learner, it cannot follow it with a second postulate specifying that certain aspects of teacher behavior will influence learning. The inconsistency can be resolved by moving to an interaction theory, which specifies limited control both internal and external to the learner.

IV. An instructional theory should be congruent with empirical data. If the facts from modern investigations of language and linguistics say that vowels change their sounds depending on the consonants before and after them, and upon the dialect of a speech community, then a theory for teaching phonics based on these present discoveries cannot assume that any set number of graphemes can be taught to equal the sounds of the vowels. Yet the Initial Teaching Alphabet instructional system does exactly that.

Propositions of the theory should be properly derived from the data on which they are based. It is of crucial importance to a scientific theory that it be based on data. Each generalization that constitutes a segment of an educational theory must be based on specific protocol statements derived from specific studies. The statement of the theory should be properly documented so that the reader can go back and examine the protocol statements and the data on which the protocol statements are based.

Some contemporary theorizing about education is completely undocumented and some is even in a worse way in that the references cited to support the postulates of the theory bear little relationship to the generalizations they are claimed to support. Accurate documentation of the sources of evidence on which a theory is based and a credible relationship between the evidence and the theoretical position is a minimum requirement for any scientific

theory. Since the development of generalizations from data involves inductive inference, an element of judgment is always involved, and the boundaries of the generalizations thus derived must always be established through further empirical studies.

Personal experience and single case histories are not generally admissible as evidence to support the propositions of a theory. In addition, evidence remote from the generalization should not be introduced, for it can lead to false generalization. For example, much that has been written about the theory of instruction on which teaching machines are based stresses the importance of immediacy of feedback—a position derived from experiments with subhuman subjects. Yet the more recent evidence derived from experiments with human subjects indicates that immediacy of feedback is generally unimportant in concept learning.

V. An instructional theory must be capable of generating hypotheses. If a theory is written in broad terms, poorly defined, it may not be possible to see how aspects of it can be tested. The postulates have to be stated in such a way that hypotheses clearly present themselves. For example, if we look at the model presented at the beginning of the chapter, a whole host of hypotheses are derivable from postulates which state interrelationships among the variables. One such hypothesis might be of the order: Given the goal of developing analytical ability in relation to concept A in social studies, when first graders of average intelligence in a suburban school are presented series X, Y, Z of concrete operations and receive instructions of the type B, C, D from a female teacher located at point E on a circumflex measure of control and warmth, the concept will be attained more efficiently than when taught in other sequences by other teachers.

Of course, for the sake of brevity, the "other" conditions are not specified here, nor are the substantive statements which would take the place of the symbols used above. That would depend upon the theory. The further elaboration of how location of the teacher on the scale, and efficiency, and "receive instructions" are measured would also need to be spelled out in the design. The point is that any instructional theory must lend itself to such statements.

VI. An instructional theory must contain generalizations which go beyond the data. Unless links can be made between the findings of a particular investigation and other investigations, the work does not lend itself to prediction. The power of a concept, or generalization, is that it allows one to deal with unknown events on the basis of known classes. The power of a theory is enhanced only when one can make predictions in like manner. The accumulated bits and pieces of empirical studies only gain utility when they can be interwoven into a set of generalizations at a higher level of abstraction than the conclusions themselves.

VII. An instructional theory must be verifiable. As stated in the first chapter, one of the problems is the language in which postulates or hypotheses are stated. If the terms are ambiguous, then data collection is difficult. There are other problems. It is possible for all the terms to be stated properly, but data to be unobtainable. For example, "When the child is given complex learning tasks, his brain increases its capacity for learning through altered chemistry." It is demonstrable in rats that early complex training leads to higher brain weight and increased secretion of cholinesterase, but it is not demonstrable in humans. Reasoning by analogy does not meet the test of this criterion.

VIII. An instructional theory must be stated in such a way that it is possible to collect data to disprove it. The statement of terms may be tautological, that is, the reasoning may be circular. For example, if reinforcement is defined in such a way that it is always possible to read its presence in the theory, or if perception is always inferable from behavior, then it is impossible to test some basic postulates from learning theory or perceptual psychology. If one says, "Pupil classroom behavior is a function of teacher personality," he may be expressing a truism, but one that cannot really be tested in the form stated.

IX. An instructional theory must not only explain past events but also must be capable of predicting future events. Many personality theories have been historical in their approach, reading behavior backwards. For example, in psychoanalytic theory, the present behavior of an adult is seen as a function of particular classes of events in his past. The connections are often tenuous, with many missing links. Even if demonstrable, the theory serves to explain how a person became what he is, rather than predicting what he will become in the future.

In instructional theory, if *post hoc* reasoning is used to explain results of investigation, or if one can only go backwards with it, the power of the theory is greatly reduced. Explaining student performance is insufficient; prediction is necessary. It should not be assumed that this means a belief in determinism, or simple antecedent-consequent relations, but rather that predictions must be made concerning the probabilities of a given change in student performance under stated conditions.

X. At the present time, instructional theories may be expected to represent qualitative synthesis. Ultimately, a theory should be expressed in terms of quantitative relationships among variables. Propositions in educational theories may be expected at this time to appear in the general form "Increments in condition X produce increments in achievement Y in pupils characterized by attributes A, B, C, etc." In such a statement, X may be an attribute of teacher behavior, such as how frequently he makes rewarding statements, or it may refer to a property of the physical learning situation such as how

frequently the pupil encounters a particular word in context. Y is a measure of achievement derived from a test, an observation procedure, a spontaneous product or whatever else is appropriate.

The statements will indicate virtually nothing about the size of the increment in the one variable that will produce a particular increment in the other variable. In this respect, the statements of any theory of instruction that is likely to be evolved lack precision. However, there are immense difficulties in the way of producing statements for a theory of instruction that have greater precision. The major difficulty is the lack of an appropriate system of units for measuring the variables involved. Insofar as a theory is needed as a general guide to action, qualitative statements could be sufficiently precise. Indeed, little might be gained if the statements of the theory were transformed into more precise mathematical relationships. Although research workers have hopes that the qualitative generalizations that they derive from research may someday be refined to the point where they may assume the form of mathematical equations, many would doubt whether this hope can ever be realized.

4

The Functions of Instructional Theory

THE COMMISSION has delineated areas in which instructional theory can be assessed for its utility value. These are: research, teacher behavior, teacher education and supervision, and curriculum development. Before discussing each in turn, a general view of function seems appropriate.

When theory is mentioned in an educational context, the discussion generally carries with it the implication that the central and single function of the theory is the guidance of teacher behavior. This is a very narrow conception of the function of theory.

Kaplan⁸ has pointed out that scientific theories serve many purposes besides those of providing guidance in the solution of practical problems. First, theory construction serves the function of forcing the theory builder to bring together in a concise and parsimonious form the knowledge that is currently available. It forces him to review carefully what is known and to separate that knowledge from both tenuous speculation and the body of ambiguous findings. Second, it replaces, in a sense, the large number of protocol statements found in the supporting studies with a relatively few generalizations that are inductive inferences from them. The stated generalizations are formulated in such a way that they lead to better prediction and control than any other alternative sets of generalizations. Third, the theory thus formulated becomes a basis for research. Not all research has to be theory oriented, but much that has been of immense value in advancing knowledge has been.

The advances produced by research in the natural sciences would have been unthinkable if work on theory construction had been curtailed. *Theories*

⁸ Abraham Kaplan. *The Conduct of Inquiry*. San Francisco: Chandler Publishing Co., 1964.

suggest experiments and ways of advancing knowledge. Perhaps many of the inadequacies of research on teaching at the present time stem from the lack of theories of instruction formulated in scientific terms. History certainly substantiates the point of view that the formulation of scientific theories is an essential activity in the advancement of knowledge. Finally, the development of theory simplifies the communication of knowledge that has been acquired, for massive quantities of supporting data become replaced by a few generalizations.

The road which leads from the validation and acceptance of a theory to the point where the theory becomes applied to the solution of a practical problem is typically a long one. For example, nearly a quarter of a century has passed since laser beams were first systematically investigated in the Bell Telephone Laboratories and theoretical explanations for them were first evolved, but it is only in the last few years that some experiments have begun with the practical applications of the theory of laser beams to problems of long-distance communication. Perhaps even a longer period may be expected to elapse between the first development of a scientific theory of instruction and the beginnings of the application of that theory to the solution of problems of the classroom.

Finally, the point must be stressed that although an empirically based theory of instruction is derived from data collected under conditions that now exist, it can lead to developments far beyond any of those envisaged by contemporary practitioners. One can do well to reflect on the fact that the theory necessary for the commercial use of nuclear energy existed long before any such use was ever evolved. Scientific theory, though based on the known, is a guide for the exploration of the unknown and leads to developments that only a generation ago were not even in the stage of being dreams.

Models and Theories

The current literature reflects considerable semantic confusion over the labels "model" and "theory." Before assessing either, the terms must be understood.

A distinction is made in this publication between *models* and *theories*—two terms that are often used interchangeably. The differentiation made here follows the excellent article on the subject by Chapanis.⁹ Models are just analogies which help one to think about problems. Scientific theories are vastly more than just analogies for they must have some degree of empirical truth. A model is just a convenient way of looking at things, but a theory has

⁹ Alphonse Chapanis. *Man-Machine Engineering*. Belmont, Calif.: Wadsworth Publishing Company, Inc., 1965.

to reflect knowledge and, to be accepted, must have been demonstrated to provide a means of predicting events.

Educational Models

Models of learning and instruction have long been used by philosophers and pedagogues. Aristotle, for example, introduced a model of learning that involved the association of ideas. Learning was represented in this model as the development of bonds between ideas stated in the mind. This model of learning, later embraced by the British empiricist philosophers, was the basis for much of the rote learning that has long played a major role in schools. This model was later modified and complicated by other philosophers. For example, Herbart, while generally accepting an associationist position, took the view that learning was more than just a matter of associating together ideas, but that the ideas had to be fitted together in a certain order. The internally ordered system of ideas was denoted by him as the *apperceptive mass*.

In more recent times, the computer has commonly been used as a model of the learner and those who use such a model refer to the inputs of information to the learner, the storage and retrieval of information within the learner, the coding of information, and so forth. Some models find their roots in religion, as does Froebel's model that essentially involves a representation of man as a learner with a self-energized soul striving to maintain its unity and achieve perfection. These different models of man as a learner have evolved because thinkers have found them convenient ways of thinking about learning. They are not in any way research based, though they have had influence on the direction of research.

Educational Theories

A scientific theory, in contrast to a model, has to be based upon empirical evidence, and it has to demonstrate a capacity for predicting the occurrence of events before they happen. A theory of instruction in reading must indicate the effect of a variation in the procedure of instruction on the achievement of the pupil. Such a statement relating procedure to achievement must be derived from empirical research. For the statement to survive as a part of a theory of reading instruction, further evidence would have to be collected that changes in specific aspects of reading instruction, as specified by the theory, would actually produce changes in reading achievement.

Models are often the precursors of theories. The model of the atom as something like a billiard ball, but very much smaller, evolved in an era when there were no means of investigating atomic structure. Later the billiard ball representation was adorned with hooks to represent valences and organic

chemistry evolved largely on the basis of this kind of model. An interesting point is that this model continued to be used long after scientists had shown that it was a very poor representation of atomic structure. Somehow the model was of value in helping scientists think about problems of chemistry even though it did not do justice to atomic complexity. Models that provide simple analogies seem to have great value in facilitating thinking. Such models are useful in their own right.

Most formulations of the pattern of behavior recommended for the teacher represent models rather than theories. The various descriptions of how the teacher should behave when conducting a class along the lines represented by the advocates of discovery learning represent a model of teacher behavior. The Progressive Education Movement of the 'thirties also proposed a model of teacher behavior, as did Montessori and Froebel. Teacher education programs virtually could not exist without models of teacher behavior after which they may help students of education to pattern themselves. Models of teacher behavior represent a legitimate area of study and much more needs to be known about the kind of models that students of education can incorporate into their own behavior and those that are difficult to incorporate.

Functions of Theory in Research

Although we have stated that the way may be long between the formulation of theories of instruction and their practical application in the classroom, in the long run one can examine the value of a theory in terms of its relevance to the above five areas. The first area of relevance, and one stated throughout Chapter 3, is research. One expects that a scientific theory will prove its worth by the research it engenders. The value of a scientific instructional theory can be determined by the amount of theory-based and theory-testing research carried on in both laboratory and classroom which elucidates and quantifies the relationships among the classes of variables presented in the definition. If the theory meets the test of the criteria listed in Chapter 3, it will possess this form of utility value.

Functions of Theory in Teacher Behavior

The vision of a teacher applying instructional theory in the moment-to-moment decisions that he makes is the pipe dream of many professional teacher educators and supervisors. Indeed school supervisors and supervisors of student teachers have been eternal optimists about having their clients, if you will, call upon theory at every move in the classroom. A common question that the supervisor asks after observing several segments of a

teaching behavior is, "Why did you do it that way?" The supervisor is hoping that the teacher was carrying out some explicit bit of theory and that he will be able to tell him so. But this is difficult to do. In fact it probably cannot be done because of the intuitive way in which teachers act.

If one could combine terms from a couple of psychological viewpoints, the teaching act might be best described as being an initiated intuitive gestalt of many factors perceived by the teacher at the moment in relation to flashes of insight drawn from experience and personal conceptions of teaching that probably has some vague individualized theoretical base. The immediate tactics of the teacher in a classroom tend to be intuitive, yet there is no reason why the conceptual element in intuitive acting cannot be grounded generally in sound instructional theory learned by the teacher.

An instructional theory, as a theory, stands outside the teacher and specifies the teacher as one of the interacting sets of variables. As such, the teacher cannot invoke this or that theory of instruction at a given moment because he is a variable in the situation.

He can, on the other hand, be sensitized to being aware of the total instructional situation including goal, pupil, and instructional setting characteristics.

In the totality of teaching, which includes a planning stage, there is a crucial point where instructional theory can be injected. This point is at the time when the teacher is planning his instructional strategies; for example, whether he will use an inductive or deductive approach, given the general pupil characteristics and available instructional materials.

A theory of instruction can specify a set of relationships between pupil behavior and other aspects of the instructional setting other than teacher behavior, or indicate teacher behavior as a constant. Under these conditions the teacher might be able to use the theory consciously in a pre-operational planning stage to manipulate the non-teacher variables such as those related to media, sequence, level of abstraction, length of time, class size and organization.

Teacher Education and Supervision

For years teacher educators have been asking the student teacher to put theory into practice. They have said that student teaching is useless unless the neophyte has an opportunity to put to work the theory he learns at the college. Theory is rarely defined in these demands, but the parties concerned seem to assume that it has something to do with a body of descriptive facts about child development, and a collection of "methods" recommended in curriculum courses. These demands seem straightforward enough except that supervisors then exhort the students to develop their own theories. At this

point students might well ask, what is theory? And here is where a new teacher education about the nature of instructional theory and its teaching can begin.

Student teachers and experienced teachers need to be able to recognize the different types of theories and to be aware of their power, their limitations, and their appropriate uses. For example, the idea that a teacher is an "influencing agent" and that his acts therefore have moral implications is a humanistic type of philosophical theory. It is not an empirical type of theory of the kind considered here. Such theoretical positions cannot be used in the empirical development of instructional methods but they can help a teacher in broadening his perceptions, his role in society, and in giving him a new stance in the classroom.

A teacher can learn that many of Dewey's ideas are propositions that make good sense. They were empirically derived but they cannot be scientific theory until they have been rigorously tested. For example, the theory that intrinsic motivation produces more effort has a certain soundness but until it has been through the crucible of precise assessment according to the criteria for development of scientific theory it can only serve as a sensible guide to classroom practice. On the other hand, when Kounin's analysis of videotaped classroom management incidents suggests that teaching strategies which involve pupils in their own structuring of their study tasks produce an "attending" atmosphere in the classroom, then teachers can be reasonably certain that similar strategies in their classroom will produce similar effects.¹⁰ Dewey's intrinsic motivation idea has been in part substantiated by Kounin's experimentation.

Teachers also need to know how to judge the validity of theoretical statements that claim to be scientific. Otherwise they will fall into the trap of pseudo-science which, for example, surrounds so many of the commercialized reading programs that claim to solve all reading problems by one approach.

Pseudo-scientism is one of the greatest deterrents to educational theory advancement because the pseudo-scientist in education tends to be rigid and authoritarian. His ways are sure and final. He does not understand the tentativeness of all true scientific investigations and theorizing. Teachers can be easily persuaded by fake theory unless they become somewhat sophisticated in theory building and criticism.

Teachers also need to have facility in extrapolating theory from methodological models so that intended or assumed theory can be brought into the open and examined before an educational program is adopted.

Once models are formed from the descriptions and exhortations of most

¹⁰Jacob S. Kounin: "An Analysis of Teacher Managerial Techniques." *Psychology in the Schools* 4 (3): 221-27; July 1967.

curricular and instructional proposals, they can be analyzed. If they suggest scientific foundations, then the bases for them can be examined according to the criteria. Most of the new curricula are based on models of various sorts. All teachers and supervisors cannot attain the fine skills needed for a thorough assessment of a program, but they need to know how to raise theoretical questions and how to read and judge prepared assessments. Hopefully a study of the nature of theory and its development would make teachers and supervisors the wiser in their professional judgments and actions.

Functions of Theory in Curriculum Development

The second area of utility value is curriculum development. Although we have not discussed how goals are determined and have confined our statements to the achievement of goals which were modified only by pupil and instructional variables, a curriculum proposal must take into account the other variables. When the statements about the relationships between pupil, instructional setting and goal characteristics meet the criteria presented in Chapter 3, then the curriculum developer is in a much better situation not only to plan his content and sequence but also to assess its merit. For example, a curriculum recommendation in social studies which overlooks such pupil and teacher characteristics as age, race, class background, and other demographic factors leads to an unused, or at best a misused package. Similarly, when naive assumptions about group processes among adolescents are made, so that teachers are instructed to "put pupils in small groups," the curriculum design is faulty, and data collected to test it may not prove its worth because of the variety of ways teachers followed the instruction. For a sample of an early attempt to use the guidelines in this fashion, see Appendix A.

The curriculum recommendation should specify student outcomes and give clear indication of the process and flow by which the content, with given students and particular modes of presentation, leads to changes of behavior. Failure to do this decreases the potency of the recommendation. The research in classroom grouping is a case in point. This administrative device for influencing learning has often been used without specifying why it should be effective, or without indicating what changes in instruction should accompany the administrative change. School organization, as a reflection of manipulation to achieve curricular outcomes, often fails to support its case through research because it lacks theory and precision.

We bring this paper to an end hoping that we have not ourselves begged the issue of instructional theory by dealing with it in a meta-theoretical fashion. Throughout our three-year history as a Commission we have constantly asked ourselves what would be the most useful task that we, with

our backgrounds, could perform. How could we serve the Association and the profession best?

Our answer was in deciding not to build a theory by commission, but to encourage others to do so by laying out the road. We hope the paper will encourage debate, lead to research, and eventually, to theories of instruction. It has proven an enlightening experience for us. We have had a three-year seminar. Unfortunately, we can only share our product, not our process. The Commission's term is over; the task of theory building still remains. In the meantime, we hope these guidelines will serve both the scientist and the practitioner as the former builds his theories and as the latter assesses the many curricular and instructional recommendations now being made to the profession. We see this paper as the first step in a process of taking a new look at curriculum and instruction. We see the Association for Supervision and Curriculum Development as leading the way in this endeavor.

Appendix A

Edited Abstracts From

"Assessing Theories of Instruction"

A Paper Presented by Ira J. Gordon
at the June 1966 Conference Sponsored by the ASCD
Commission and by the College of Education,
University of Florida, Gainesville

A MAJOR purpose of this conference is to examine the assessment criteria developed by the ASCD Commission on Instructional Theory. The purpose of this paper is to demonstrate one use to which the assessment criteria can be put. Some of what I will do is perhaps not quite "fair game." In effect we shall be looking at some printed materials and statements that were essentially designed as curriculum innovations and applying to them criteria developed for instruction.

My assumption is that any curriculum innovation has, built into it, a set of implicit postulates concerning the nature of instruction. Perhaps the fairest way of assessing these curricula as they bear on instruction would be through examination of actual classroom operations. This, however, is not feasible for a presentation, so we will adopt this round-about approach of a logical analysis rather than an empirical analysis of what actually goes on in the learning situation.

This asks a great deal of the educator, or his colleague from some basic discipline, who wishes to develop or suggest new curricula for consideration by schools. It also asks a great deal of curriculum and instruction people and classroom teachers who need to examine their present operation to see just what is implied in what they are currently doing.

We will examine printed materials, in relation to the list of specifications (see Chapter 3 for list and chart). In order to handle the cognitive load, I shall state them as follows: what assumptions, postulates, or hypotheses are evidenced in the material concerning such pupil characteristics as (a) the

nature of the child and (b) the nature of how children learn or how learning occurs; concerning such instructional situations as (c) the sequencing of experiences, (d) the selection of didactic materials, and (e) the nature of interpersonal relationships; and concerning goal characteristics, (f) both the immediate and long range goals and purposes?

The Madison Project

In order to test whether these procedures are usable, we will look at Robert Davis' Madison Project. Although this may not be a typical sample in that it is not a curriculum for all children and for all their mathematics, it does present an integrated systematic approach. How would Davis answer the preceding six questions?

The Nature of the Child

1. It is clear that Davis sees the child as a cognitive information processor. He is concerned with the development of concepts rather than the learning of isolated facts. For example, in his instruction to teachers he says:

Try to get the student to think about the basic concepts as early as possible. . . . he can learn names and calculations later on, after he has thought about the concepts in a creative way for some time. . . . every effort should be made to get the students thinking and talking, *not* listening and accepting (Davis, 1964a, 18).

In the first place, an orientation based upon the notion of the *gradual modification of the individual's internal cognitive structure* appears to us as highly appropriate for studying the learning of mathematics (Davis, 1964b, 16).

2. The Madison Project uses curiosity as its main motivational concept. Although, as we shall see when we look at learning, it also utilizes its own brand of positive reinforcement.

It is clear that many fifth graders "think like scientists"—they want to get answers to questions for direct intellectual satisfaction. . . . the scientists, and the fifth grader, are motivated by curiosity—are excited by intellectual adventure (1964a, 2).

The fact is that children learn because they are free, because they are respected, because they live in a good town and go to a good school and have good teachers. They learn because they want to learn. They learn because, on the one hand, they are happy, and because, on the other hand, intellectual challenges are abundantly present in many attractive forms (1964a, 7).

3. In reference to the alterability of development by instruction, the Madison Project assumes that, in mathematics, school experiences are essential.

Since ordinary life fails to build readiness for the study of mathematics, this task evolves upon the schools (1964a, 4).

4. The role of maturation is almost seen in reverse by Davis. The position is taken that preadolescents are far more ready for the introduction to abstract learning than are adolescents. Preadolescents are seen as more theoretical, adolescents as more practical. The introduction of abstract experience should be earlier in the grades. There is the assumption that readiness builds on earlier experience and that this experience in mathematics at least must be encountered in the school. Davis states in effect that readiness for language can be built in the home since it is part of natural growing up, but that the type of abstraction required in mathematics does not come naturally to the child in ordinary living.

The student has *not* lived in a world of ubiquitous quadratic equations. For him, the vocabulary, symbols, concepts, techniques, objectives, structure, and convention of mathematics are entirely new (1964a, 3).

How Children Learn

1. The notion of positive reinforcement permeates the thinking behind this project, although Davis does not say so. It is not positive reinforcement in the same way that Skinner would talk about reinforcement schedules, but let Davis' words speak for themselves.

When a student's statement contains a largely correct idea couched in somewhat uncertain language, *we nearly always respond to the positive part of his behavior*—namely the correct idea. We do not (well, hardly ever) respond to the wrong part of his behavior, in this case the doubtful verbal formulation (1964a, 15)

We want an *encouraging* word from the teacher. . . . we do *not* want a *discouraging* word from the teacher (1964a, 16).

Under the heading of the provision of success experiences, Davis cautions the teacher:

Nearly every student's answer has some merit if only as a courageous try. Attempt to respond to every student answer as a scientist might—it is an answer and it deserves respect (1964a, 19).

It is, however, important to know that the teacher's response is to be guided not by the correctness of the answer but by the spirit of encouraging the child to continue to try.

2. In place of demonstration and observation, Davis stresses experience and participation. Indeed, if there is a key concept in his approach, it is this ambiguous notion of experience. Sometimes one infers experience for experience's sake, although this is really not what Davis is after. He says:

In general, there are two kinds of experiences which we provide for the children: experiences where children *do* something, and experiences where a "seminar" of children *discuss* something, under the leadership of a teacher. Both kinds of experiences are so different from usual "mathematics lessons" that we have had to give them a distinctive name—*informal exploratory experiences* (1964b, 3).

Experiences are often seen as the end as well as the means. There is, however, a set of criteria for choosing experiences. Merely, in outline form, they are: (a) adequate previous readiness, (b) relation to fundamental ideas, (c) the student must have an active role, (d) concepts must be learned in context, (e) interesting patterns must lurk under the surface of the task, (f) the experiences should be appropriate to the age of the child, and (g) the sequence of "informal exploratory experiences" must seem to "add up" to something worthwhile. The last point would seem to indicate that the building of intellectual structure and the notion of the structure of discipline both have to be assessed in determining the worthwhileness of an experience.

3. Group discussion is a main vehicle for conveying experience. There is not necessarily physical activity in the usual sense of dealing with concrete objects, but there are discussions among the children in relation to an abstraction that may have been placed upon the blackboard.

4. Guided learning, stressing the importance of focusing, would seem at first look to be the antithesis of discovery as viewed by the Madison Project. For example, as an explanation of why curiosity seems to be lost between childhood and adolescence, Davis says:

In academic learning the child finds that he has lost the initiative and that he is surrendering an increasing portion of his independence. He is learning what *grown-ups* think he needs to learn; he is operating under the direction of *grown-ups*; his work is being evaluated by *grown-ups*; and the goals and values have been determined from the *grown-up* world. . . . *Initiative presupposes independence* (1964a, 4, 5).

Sometimes a superficial view of the Davis project leads to the notion that all learning is fun and games with no payoff. His instructions to teachers resemble very much Montessori's instructions to her teachers.

What we *can* do is to try to observe ourselves as carefully as possible and watch to see which error we make most often—allowing too much drifting or imposing too much adult interference. We can attempt to practice self-restraint, to avoid too much teacher talk and too little child response. We can attempt to observe children while teaching, to avoid pushing too strongly *our* direction, too weakly in their direction. We can also remember the observation of an astute teacher: Children can not *choose* to do something they have never even heard about. We must acquaint them with many attractive alternatives if they are to exercise any right of selection (1964a, 6).

The Sequence of Experience

The teacher plays a central role as the organizer of experience, although this seems to be more an art than a prescription. Davis defines a teacher as a moderator or a discussion leader, as one who asks a series of leading questions, and as one who observes and listens to children.

An important feature also is the device of asking the children a carefully devised sequence of questions, which gradually lead them to formulate techniques of solution and to discover generalizations (1964a, 8).

The sequence is controlled by the nature of the subject matter.

The teacher has tried to remove himself from the role of middle man: he has tried to step out of the way, and let the child look directly at the mathematical structure itself (1964b, 5, 6).

Although the child may have the impression that the experience is haphazard, and although there is no real effort to strengthen the sequence and eliminate all "noise," nevertheless the sequence is determined by the structure of the discipline. This is what the child is to discover.

Only the most consistent "poker voice" and the careful withholding of cues and answers really leave it up to the child to discover the internal organization of the subject (1964a, 9).

The child in the Madison Project classroom is expected to utilize trial and error learning as a part of the discovery concept. In an early lesson, the children are expected to deal with the following problem:

What number can we write in the to make a true statement?

1. $3 + \text{$ = 5
2. $8 + \text{$ = 12
3. $5 + \text{$ = 16

In Davis' instructions to the teacher he says, "The method by which the student will solve these three equations will be by guessing," by "trial and error."

The teacher is not to give answers or let the child know exactly what is expected or to be discovered. Davis says:

In our "experience" lessons we structure the situation as little as possible. . . . in our "seminar discussion" lessons there is at once an appearance of a relatively highly structured situation, and at the same time an appearance of great flexibility. After wondering about this seeming paradox for some time, we have come to believe that the "good" Madison Project teacher possesses, in his head, the ability to construct suitably designed "branching programs" at a moment's notice (1964b, 11).

The Selection of Didactic Materials

There are no concrete materials utilized in the sense of the manipulation of objects. The main materials are quadratic equations in which a graph is used. Sets and equations are also the beginning point of the work. The experience provided for these youngsters is often through a guessing game or games such as a modification of Japanese "Go."

These are not practical materials in the old sense of learning to shop for groceries. They are abstract and theoretical, in keeping with Davis' view of the preadolescent as an intellectual being with curiosity. Nevertheless these materials are concrete in the sense that the child can assess his answer against whether it works or not, rather than relying upon authority judgment from the teacher. In this sense the materials serve as self-teaching devices.

The Nature of Interpersonal Relations

There are positive injunctions in the Madison Project for how the teacher is to behave. The teacher is an encourager and respecter of the child, providing a warm, accepting climate. The program is seen as successful because:

The teachers like children, and they respect learning and maturity and resourcefulness. The children are treated with the complete respect that every human being should receive, but which is ordinarily reserved for adults. The child in these schools is not reprimanded for not saying "thank you" but his superiors would be very sure to say "thank you" to *him* whenever he has handed them something or done something for them. It is for the child to decide what attitude he will take toward his superiors, but their attitude toward him is to respect him as an equal, and a friend (1964a, 6, 7).

Goals

Again Davis' words can speak for themselves:

We are not primarily concerned that children should learn facts and routine techniques. We are particularly concerned that they learn creative problem solving, the ability to discover patterns in abstract situations, that they come to a realization that mathematics is indeed *discoverable*, that they acquire faith in their own personal ability to make mathematical discoveries, that they acquire self-confidence, that they acquire an honest self-critical ability, and that they come to regard mathematics as "fun" (1964a, 11).

Further:

Topics are chosen to provide experiences with fundamental concepts and techniques with which the children should become familiar, which provide for active

participation, and which should provide abundant opportunities for the children to make discoveries (1964a, 19).

and:

The aim is for nothing so trivial as a "level of achievement" (1964a, 20).

A key purpose is to immerse youngsters in mathematical experience so that they will become familiar with the concepts *indirectly* and so that they will then be able to utilize them without necessarily being conscious of their knowledge.

We have mentioned two kinds of knowledge: the unreliable kind that is embodied in rules and the more versatile kind that is embodied in pseudo-geometric mental pictures. But there is a third kind that is so secure, so reliable, and so easily available that we are hardly aware of it. This is the kind of knowledge that is represented by experience (1964a, 3).

Nowhere is it clear that children are ever asked, in the Madison Project, *why* they should wish to learn whatever is being presented. It is assumed that curiosity is a sufficient beginning motive and that competence will take care of itself, although certainly competence is a goal. There are no concepts of transferability, and what is to be discovered is to some degree left to chance. There is further no, to use Davis' terms, "specified level of achievement." In this respect, what is learned by each youngster is highly individual, and Davis is not concerned with verification.

Major concepts are that the notion of fixed maturation must be called into question, and that instruction or experience of particular kinds may very well lead to modification of cognitive structure.

References

Robert B. Davis. *Discovery in Mathematics, A Text for Teachers*. Boston: Addison-Wesley Publishing Co., 1964(a). Copyright (©) 1964. All rights reserved. Reprinted by permission.

Robert B. Davis. "The Madison Project's Approach to a Theory of Instruction." (Unpublished mimeographed paper.) 1964(b). 41 pp.

Appendix B

A Model for Curriculum Development Decision Making¹¹

by Ira J. Gordon, Chairman
ASCD Commission on Instructional Theory

GROWING out of a decision by the Commission on Instructional Theory, a meeting of several interested ASCDers was held, on March 31–April 1, 1967, in Washington, D. C. The object of the meeting was to discuss the problem of overall curriculum design and the ways in which theory influences school practice. Those in attendance, in addition to Leslee J. Bishop, Louise M. Berman, and Richard V. Brown of the ASCD staff, were Arno Bellack, Ira J. Gordon, Kenneth Hovet, James B. Macdonald, Paul R. Klohr, Richard Miller, and Louis J. Rubin.

As it worked, the group evolved a model of the decision-making process on the local level. This model assumes a "package world," in which the local decision maker is faced with the task of selecting and integrating various curricular packages rather than beginning to design curriculum from scratch. The model on page 42 indicates a systems approach to the problem.

Step by step, let us suppose that a school system is faced with a choice in the field of social studies between package A developed by the X group, and package B developed by the Y group. On the model, arrows pointing toward the square indicate the factors which might be seen as affecting choice. Beginning in the upper left hand corner, the guidelines developed by the Instructional Theory Commission, available in this publication, can be applied separately to each package. Several key questions can be asked concerning the materials. What assumptions are there in the materials (a) about the

¹¹ Reprinted from the *ASCD News Exchange*, May 1967, Supplementary Edition. 4 pp. Copyright © 1967 by the Association for Supervision and Curriculum Development, NEA. All rights reserved. This article or any part thereof may not be reproduced in any form without the written permission of the publisher.

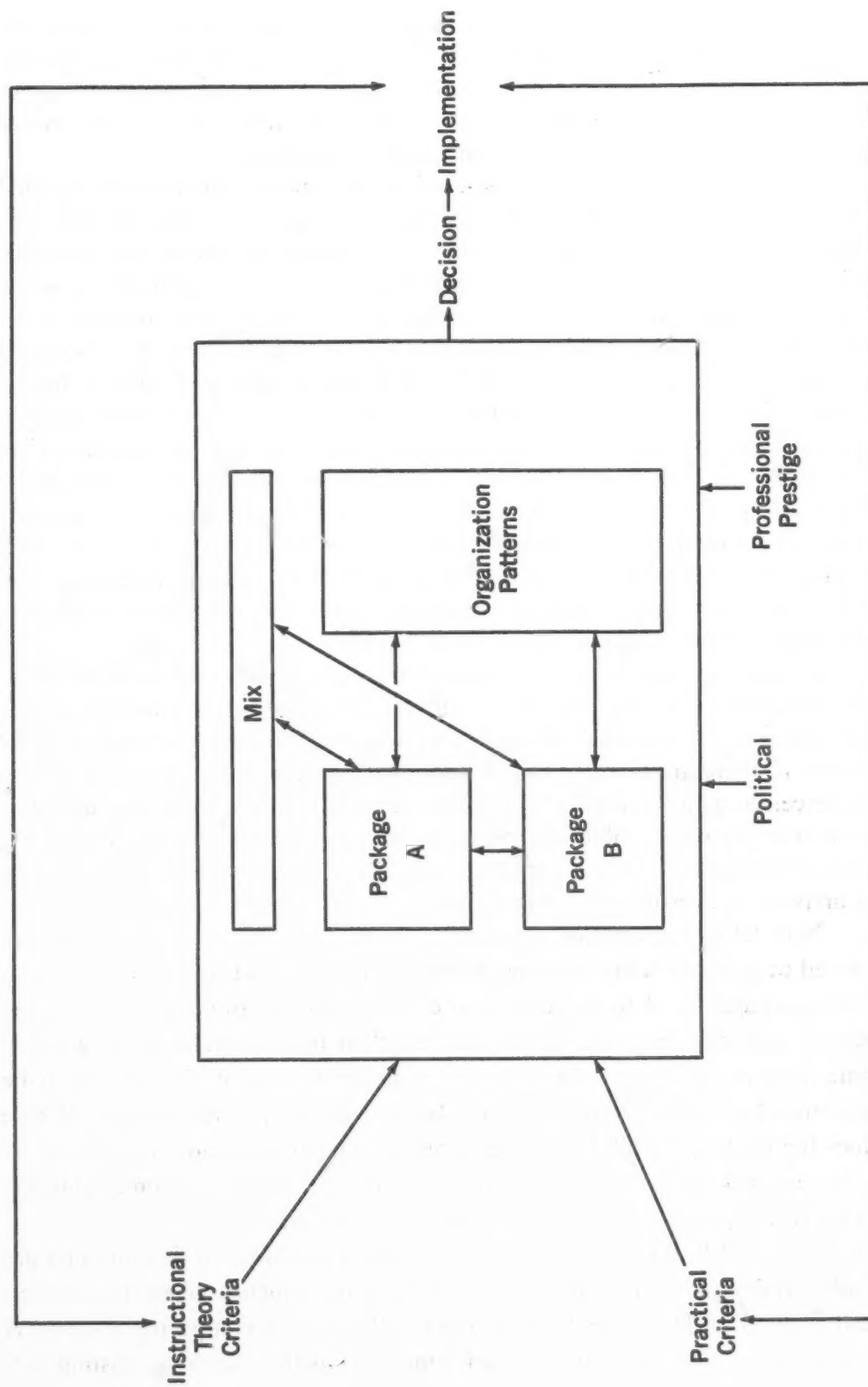
nature of the learner, (b) about the nature of how one learns, (c) about the appropriate sequence of materials and events which may be based upon some view of development of the child or the nature of the discipline, (d) about teacher-pupil relations? Finally, what are both the immediate and long-range goals that the package maker has in mind for children?

At the lower left there is a second set of criteria that must be applied separately to packages A and B, and which become inputs into the decision. What is the cost? Here we must evaluate not simply the cost of the materials, but the cost per pupil for length of time to accomplish the particular goal the material implies. We need to be hardboiled and apply cost analysis in the process. Second, what kinds of in-service teacher education needs are created by the purchase of a particular package? Is the present staff able to implement it or does it require extensive reeducation? Third, what is involved in evaluating the effectiveness of the package? What kinds of measurements are available? Do present measurement techniques lend themselves to the goals? What kinds of new assessment and evaluation materials would be required? How long would it take before reasonable evaluation can be made? Can evaluation be accomplished at the end of units or at the end of years, or can it be done only after a period of years? There are, of course, additional practical questions. These merely are illustrative.

Coming up from below are two other inputs. What is the political situation as it affects the decision? Who wants the package? How powerful are the advocates of the package? Why do they want it? Although we may not like to face it, there are questions of professional prestige. Will the school system be perceived as a "swinging" school system if it climbs aboard and adopts a particular package? Will this give the school system prestige? Will other school systems look to this one as a leader? Such questions must be dealt with in arriving at decisions about such an adoption.

Now let us move inside the square. Now information and evaluation are related to package A and package B separately, but this is only the beginning. Both packages need to be related to existing organizational patterns in the school, and must be examined to see what their impact might be. How much time does the package take? What is required to staff it? Where can it be accomplished? At home or in school? In large groups or small groups? Where does the package fit in? How does it relate to what is already in the system? Can the package be easily assimilated or does it require accommodation? What has to give way if either package is brought in?

A way of looking at this is to talk about a mix box. In this mix box are such variables as: time, theoretical mix, staffing, sequence, place, the learner, and evaluation. Here, the decision maker is faced with comparing package A and package B as they relate to each other and as they relate to existing pat-



terns. If package A in social studies is built upon a Piagetian base, how well can it be integrated with the math package built on programmed instruction, both of which go into a self-contained classroom? Can teachers shift bases? What does this do to children's learning? How does package A relate to the humanities which may not use either conceptual style or learning theory? Perhaps the new role for the curriculum developer or a new label for his role is to call him the "mixer."

The same within-the-system interaction between package A and package B in social studies can be applied to making choices between package A in social studies and package B in science, or seeing what happens if packages from social studies, science, math, and English can be related to each other in some sort of logical and systematic fashion. A curriculum cannot be built from simply adding these separate bits; it must be developed so that these parts relate to each other systematically. Otherwise there will be a breakdown within the system, either in what teachers can cope with or in what children can adapt to.

Out of this interactional flow of analysis of mix of package and pattern comes the decision. The decision then needs to be adopted administratively and goes into an implementation phase. Implementation again requires another kind of model which still needs to be developed. This implementation phase will then lead to feedback growing out of evaluation and research, which will influence the nature of the practical criteria. For example, what do cost data actually reveal? Do in-service education patterns work or do they have to be revised? As evaluation materials are developed and applied, these will influence further decisions.

If the implementation is well done and includes the kind of careful evaluation and research which is essential in this model, then there will also be feedback toward the development of some of the replicable data essential for the building of an instructional theory. This means then that these theory criteria need to be applied not only as the school system examines qualitatively the nature of the package, but also as it designs the evaluation phases of the implementation. As these data become available, they can be used again not only in the local system as inputs into new decisions, but also can become available to the field at large as inputs for other systems engaged both in the analysis of materials for decision making and in the design of research.¹²

In this way, the feedback loops create a continuous flow between those factors which initially affect the decisions, the making of the decisions, their implementation, and then back to new decisions as these continuously need to be made.

¹² See: Fred T. Wilhelms, editor. *Evaluation as Feedback and Guide*. 1967 Yearbook. Washington, D. C.: Association for Supervision and Curriculum Development, 1967. 292 pp.

We believe this is a reasonable and viable system and that it can become a basic action. There is a good deal of work yet to be done in spelling out the various components of this system. What is needed is reaction from those caught in the bind of making decisions as to how they see this model, what they use on the job as inputs, and how they see the role of mixer. In addition, we need to develop more elaborate and complete descriptions than this brief supplement to *News Exchange*, so that we can deal effectively with the problems of curriculum development decision making in keeping with today's realities.